Blockchains and Transaction Costs

Henten, Anders Hansen; Windekilde, Iwona Maria

Published in:
Nordic and Baltic Journal of Information and Communications Technologies

DOI (link to publication from Publisher):
10.13052/nbjict1902-097X.2020.002

Publication date:
2020

Document Version
Publisher's PDF, also known as Version of record

Blockchains and Transaction Costs

Anders Henten* and Iwona Windekilde

CMI, Department of Electronic Systems, Aalborg University, Copenhagen, Denmark
Email: henten@es.aau.dk; iwona@es.aau.dk
**Corresponding Author*

Received 08 January 2020; Accepted 08 January 2020
Published 03 February 2020

Abstract

This paper examines current business applications of blockchain technology and discusses blockchain implications for transaction costs. Blockchains are a relatively new set of technologies that can be used for various business purposes, primarily activities related to contracting. Transaction costs comprise the operational costs of contacting (searching and communicating) as well as the costs of contracting (writing and enforcing contracts), and blockchains can be used to lower, first and foremost, the costs of writing and enforcing contracts. Other technology applications that have been investigated to a larger extent, such as multi-sided platforms, primarily help in lowering the costs of searching and communicating, while blockchains can contribute to lowering the costs of contracting.

Keywords: Blockchain, transaction costs, contracting.

1 Introduction

This paper examines current business applications of blockchain technology and discusses blockchain implications for transaction costs. Transaction costs are in popular terms the costs of 'doing business' and the use of information and communication technologies in different business processes can affect

Journal of NBICT, Vol. 1, 33–52.
doi: 10.13052/nbjict1902-097X.2020.002

the overall transaction costs – mostly in a positive manner lowering the costs of transactions.

Blockchains are a relatively new set of technologies that can be used for various business purposes, primarily activities related to contracting. Transaction costs comprise the operational costs of contacting (searching and communicating) as well as the costs of contracting (writing and enforcing contracts), and blockchains can be used to lower, first and foremost, the costs of writing and enforcing contracts. Other technology applications that have been investigated to a larger extent, such as multi-sided platforms, primarily help in lowering the costs of searching and communicating, while blockchains can contribute to lowering the costs of contracting.

The paper first briefly explains what blockchain technology is and the areas in which it has found its initial use. The paper, thereafter, presents different theoretical approaches to the potential implications of blockchain technologies with an emphasis on transaction costs. Much discussion on blockchains has hitherto concentrated on the potential transformative and disruptive implications of blockchains, e.g. (Davidson, De Filippi, and Potts, 2016). In the present paper, emphasis is on examining examples of business areas, where blockchains already are being used. Three application areas are examined: the financial sector, real estate, and supply chain and logistics. The paper ends with an analytical conclusion.

The purposes of the paper are dual in the sense that it seeks to discuss the use of blockchain technologies in a selected number of business areas as well as to contribute to a theoretical framework to be applied in further analyses of blockchains and how they can affect the cost structures of industries.

2 Blockchain Technologies and Smart Contracts

Blockchain technology has attracted much attention since the idea of Bitcoin cryptocurrency was launched in 2008. Blockchain is not just a specific one technology. It is a combination of three technologies: private key cryptography, a distributed network with a shared ledger, and means of accounting for the transactions related to the network and records (Zheng and Xie, 2017). Cryptography plays an important role in distributed ledger technology (DLT) by identifying and authenticating approved participants, confirming data records, and facilitating consensus on ledger updates (Eichkorn, 2018).

Blockchain as a digital, decentralized ledger keeps a record of all transactions that take place across a peer-to-peer network in a chronological order. The main features of blockchain technology are: security, immutability, decentralized computing infrastructure, and consensus based rules (Zheng and Xie, 2017).

The promise of blockchain is to challenge centralized top-down decision-making through radical transparency and auto-enforceable code (Voshmgir, 2017). In a blockchain system, the ledger is replicated in a large number of identical databases, each hosted and maintained by an interested party (Rooney, 2017). When changes are entered in one copy, all the other copies are simultaneously updated. So, as transactions occur, records of the value and assets exchanged are permanently entered in all ledgers (Eichkorn, 2018).

Blockchains have also been described as a value-exchange protocol. The new way in which blockchain will process various transactions is likely to be cheaper, more reliable, transparent and faster. The blockchain's ability to store transactions and to provide an immutable record allows the participants to verify and audit transactions in principle almost with no cost.

Since 2008, blockchain has evolved to three main categories: public, private and consortium or federated blockchains. The main differences between public and private blockchain is that a public blockchain is a permissionless ledger that can be accessed by everyone and all network participants can check the overall history of the blockchain transactions. Private blockchain is a blockchain where write permissions are kept centralized by one organization and read permissions can be public or restricted to pre-approved parties. Consortium blockchain is also permissioned, but control over a consortium blockchain is not granted to a single entity, but rather a group of approved individuals (Bisade, 2018).

Until now, blockchain technology has developed in different versions, each having a specific design and new features. The first generation of blockchain is related to cryptocurrencies, such as Bitcoin. The Ethereum platform represents the second generation blockchain technology. The second generation of blochchain allows building complex distributed applications beyond the cryptocurrencies. Ethereum introduces a new application of smart contracting. The third generation adds an extra layer and links different blockchain networks with each other via smart contracts. The third generation blockchain network is designed to address the issues of scalability, privacy, interoperability and governance.

Smart Contracts

The concept of smart contract was first introduced by Nick Szabo in 1994. He defined a smart contract as a computerized transaction protocol that executes the terms of a contract (Szabo, 1994). Smart contracts offer not only the functionality of keeping all records of financial transactions entries but also allow automatically the implementation of terms of multiparty agreement. Smart contracts utilize protocols and user interfaces to facilitate all steps of the contracting process (Szabo, 1996). When smart contracts are implemented on a blockchain, they are immutable, which means that once created, they cannot be changed again. They are also decentralized, which implies that the execution and output of a contract is validated by each participant to the system and the distributed ledger can guarantee correct execution of the contract (Destefanis, Bracciali, and Ma, 2018).

Nick Szabo (1994) suggested that the main objectives of smart contract design are "to satisfy common contractual conditions (such as payment terms, licenses, confidentiality, and enforcement), minimize exceptions both malicious and accidental, and minimize the need for trusted intermediaries. Related economic goals include lowering fraud loss, arbitration and enforcement costs, and other transaction costs."

Nick Szabo explained in his paper (Szabo, 1997) that the main idea behind smart contracts is that "many kinds of contractual clauses (such as collateral, bonding, delineation of property rights, etc.) can be embedded in the hardware and software we deal with, in such a way as to make breaching of a contract expensive (if desired, sometimes prohibitively so) for the breacher" (Szabo, 1997). However, smart contracts can just execute certain pre-programmed steps and will only work if the promise of the contracts has been fulfilled.

The first smart contract was built on the Ethereum platform, which was specifically created for that purpose. Ethereum makes smart contracting possible due to the fact that a peer-to-peer system keeps track of changes to a decentralized database. The main concerns about Ethereum are the issues of security, scalability (due to decentralization) and the slow transaction speed of the Ethereum blockchain, due to the fact that each transaction needs to be processed by every node in the network. Since Ethereum, many platforms for smart contracts have been developed, such as: Hyperledger Fabric, Neo, Counterparty, Stellar, Monax and Lisk, Cardano, ICON and other networks (Bartoletti and Pompianu, 2017).

With the developments within the third generation smart contracts, blockchains are focusing on solving the main critical problems faced by previous generation, such as scalability, interoperability, governance and sustainability.

3 Transaction Cost Theory

The theory lens which is applied in this paper is transaction cost theory – a theory that was developed by Coase in his paper on 'The nature of the firms' (Coase, 1937). This paper basically argued that the reason that we have firms/companies in the economy is that there are transaction costs when doing business. If there were no transaction costs in the interaction between different business entities, all individual economic agents would act on their own and cooperate freely in loose networked structures. The theory was later explored by other economists first and foremost Williamson, e.g. (1975), who used the idea of transaction costs to discuss governance structures in the economy while placing transaction cost theory at the core of the institutional view on economics.

The reason that there are transaction costs is that there are costs of 'doing business'. In addition to the well-known production costs and transportation costs, there are costs associated with the interaction between economic (and other) units. The drivers of such costs have been summarized by Williamson (1979), (1984) to be the behavioral factors concerning bounded rationality and opportunism and three other factors concerning uncertainty, asset specificity and transaction frequency. The kinds of costs incurred while interacting between business entities are the operational costs including search and communication costs and the contractual costs including contracting and enforcement of contracts.

In the present paper, we explore the implications of the implementation and use of blockchain technology on transaction costs in selected industries, where blockchain is already being adopted. As can be seen from the references presented below, the transaction cost perspective on blockchains is already dealt with by various researchers. The examples that we have chosen are papers by Tapscott and Tapscott (2017), Iansiti and Lakhani (2017), Davidson et al. (2016), Catalini and Gans (2018), and Catalini (2017). However, in our opinion, the potential and actual implications of the use of blockchain technology on transaction costs in general and in specific industry cases needs to be further examined.

In a paper in MITSloan Management Review, Tapscott and Tapscott (2017) elaborate on 'How blockchain will change organizations' – the title of their paper. Their basic point of departure is that while 'the internet was designed to move information', blockchain is designed to move value. Their claim is that internet has facilitated the interaction between agents in markets and has, therefore, contributed to changing the organizational structure of industries and that blockchain will further change the organizational structures of industries by reducing the need for intermediaries.

Tapscott and Tapscott (2017) discuss how blockchain affects transaction costs. They write that blockchain 'allows companies to eliminate transaction costs and use resources on the outside as easily as resources on the inside'. This refers to the basic notion of transaction cost theory by Coase and Williamson that the reason that we have hierarchies/firms is that the costs of doing business 'on the outside' can be high and that the costs of managing transactions internally in organization ('on the inside') are generally lower – to a certain limit determined by the 'agency costs' (Jensen and Meckling, 1976) of the internal management of companies.

More specifically, Tapscott and Tapscott (2017) discuss the role of smart contracts in negotiating and enforcing contracts. General transaction cost theory says that entering into the multitude of short-term contracts, which companies need to do when they are small and cooperate with other business entities in networks of companies, is costly and that larger companies are vehicles for long-term contracts between the various economic agents. Blockchains in the form of smart contracts will make it possible to manage the many different contracts that small entities have to establish and will thus create a batter basis for smaller business entities to operate in markets.

In a paper in Harvard Business Review, Iansiti and Lakhani (2017) discuss blockchain technology and its use for different business and other societal purposes. The main aim of the paper is to present a model for the different phases of the adoption and use of blockchain technology. Their main claim is that the prospective adoption and use of blockchain technology will take paths similar to the adoption of the internet TCP/IP technology and that it will take a good number of years before we will see the full-blown business and organizational implications of the use of blockchains.

Iansiti and Lakhani (2017) consider blockchain to be what they call a foundational technology. They differentiate between disruptive technologies (Christensen, 1997) and foundational technologies, where disruptive technologies enter the markets with relative low functionalities but eventually grow to dominate specific markets, but do not necessarily change the whole foundation of the economy, while foundational technologies as the term indicates fundamentally change the ways in which markets work. Iansiti and Lakhani (2017) as Tapscott and Tapscott (2017) state that blockchain technology will reduce transaction costs and diminish the need for intermediaries.

The way that Iansiti and Lakhani (2017) formulate this is that blockchain technology will change ‘the way we regulate and maintain administrative control’.

Davidson et al. (2016) were some of the first researchers to present elaborate ideas on how blockchain can be conceptualized in economics terms. Their position is that blockchain is best understood as ‘an institutional or social technology for coordinating people’. They see blockchain as a general purpose technology (Bresnahan and Trajtenberg, 1995) in line with the Iansiti and Lakhani (2017) conception of foundational technology. The primary function of this general purpose technology is to decentralize the economy: ‘Blockchains are a technology of decentralization’ as Davidson et al. (2016) emphasize. The reason is that ‘blockchain technology is trustless, meaning that it does not require third part verification (i.e. trust)’ (Davidson, De Filippi, and Potts, 2016).

The Davidson et al. (2016) paper explicitly discusses blockchain technology in light of transaction cost theory. They relate the functions of blockchains to the drivers of transaction costs (Wiliamson, 1979) and (Wiliamson, 1984): Bounded rationality, opportunism, etc. The focus is on contracts and how blockchains can substitute not only for traditional contracts between different business entities but also for contracts in the sense that ‘firms exist as a nexus of contracts’ (Davidson, De Filippi, and Potts, 2016), using a concept developed by (Jensen and Meckling, 1976) and building on the transaction cost view that interactions between economic agents drive costs and that hierarchical organizations are nexuses of contracts limiting the opportunism of economic agents. As Davidson et al. (2016) write: ‘blockchains are a mechanism to control opportunism’, and ‘if blockchains can eliminate opportunism, then they will outcompete traditional organizational hierarchies and relational contracts’.

The two last papers that we refer to are a paper by Catalini and Gans, where the first version was written in 2016 and a revised version finalized in 2018, and a paper by Catalini (2017). Catalini and Gans (2018), as the previous authors, also discuss the potential role of blockchains in relation to intermediaries. They write that ‘intermediaries add value to marketplaces by reducing information asymmetry and the risk of moral hazard through third party verification’, and to the extent that blockchains can remove or reduce such asymmetries and risks, the role of intermediaries will be significantly changed. Catalini and Gans (2018) are not as radical in their view on the potentials for removing intermediaries as can be seen in parts of the literature on the economic implications of blockchains. They write that ‘while the utopian view has argued that blockchain technology will affect every market by removing the need for intermediaries, we argue that it is more likely to change the nature of intermediation within digital platforms'. In the paper by Catalini (2017), he writes that 'intermediaries will still be able to add value to transactions, but the nature of intermediation will fundamentally change'.

In the paper by Catalini (2017), he further explains this view. He writes that marketplaces enabled by blockchains or cryto-tokens as he also calls them resemble spot markets in their decentralized and incentives-driven form (Catalini, 2017) but 'can also replicate the more complex forms of governance in a traditional corporation'. There are, therefore, various ways of implementing blockchain technology for existing firms, for instance, with the purpose simply of lowering costs. However, in the longer run 'the architectural nature of the innovation may make some incumbents ill-equipped for its long-run implications' (Catalini, 2017). Such a differentiation in the aims and manners of implementing blockchain technology is in line with the stage model presented by (Iansiti and Lakhani, 2017).

In transaction cost theory, the reasons for transaction costs are, as mentioned, related to bounded rationality, opportunism, uncertainty, asset specificity and transaction frequency. And, the kinds of transaction costs can be summarized to be concerned with operational costs and costs of contracting. Our emphasis in this paper is on the implications of the use of blockchain technology on the kinds of transaction costs. Our proposition is that the implications of blockchains are primarily on the contractual costs including contracting and enforcement.

ICTs in general heavily influence transaction costs, both operational and contractual. However, emphasis has mainly been on the operational costs of searching and communicating. This applies, for instance, to the various kinds of ICT platforms that have become such forceful business models during the past decade. In our paper on 'Transaction costs and the sharing economy' (Henten and Windekilde, 2016), we explored how transaction cost theory can be used to explain the huge growth of two-sided markets and multi-sided platforms. The main function of such platforms is to reduce the operational transaction costs of searching and communicating. The main function of blockchains is to lower the contractual transaction costs of contracting and enforcement.

Blockchains obviously also have implications for operational costs. This is well explained in some of the papers referred to above. Tapscott and Tapscott (2017), for instance, explain how the transparency provided by open blockchains can make it easier for businesses to acquire relevant information on potential business partners and thus for making better and faster business decisions. Blockchains thus impact on contractual costs as well as operational costs. But the main implications are on the contractual costs. This is the reason why the present paper focuses on smart contracts.

With respect to drivers and reasons for transaction costs, we will not go extensively into this. But it would seem that the major implications of blockchains are related to opportunism in business relations and the frequency of transactions, while ICTs in general have their major impacts on limiting bounded rationality and on uncertainty.

4 Application of Blockchain Technology to Various Industries

Several industries experience various challenges in daily business operations. Technology experts foresee many applications for blockchain smart contracts to solve problems related to fraud, low efficiency, human error, cost, transparency of transactions to all concerned parties, trust and many more. This section reviews the use of smart contracts in the financial sector, real estate, and supply chains and logistics.

Financial Sector

In banking, there are many existing and developing use cases regarding the implementation of blockchain, considering that Santander Bank itself has identified 25 use cases with the main focus on international payments and smart contracts. A recent article from MEDICI lists 26 banks and financial Institutions currently exploring the use of blockchain technology (MEDICI, 2018). The main application areas are within money transfer, digital currency exchange, risk management, cross-border payment, investments, etc. The smart contract use cases focuses mostly on investment banking and capital market, commercial and retail banking and insurance.

Recent events have shown that smart contracting has the potential to be used for bonds. In 2018, the World Bank (World Bank, 2018) ordered the creation of a blockchain-based bond. The new bond will be created through Australia's Commonwealth Bank (CBA) using a private Ethereum blockchain. According to the World Bank, the bond-i will be the first in the world to be created, allocated, transferred and managed with blockchain technology (World Bank, 2018).

Another application of smart contracts based on the Ethereum blockchain can be found in lending processes. Blockchain technology can improve lending processes in retail and commercial lending, trade finance and syndicated loans. This is possible due to the fact that ordinary loan conditions can be translated into programmable rules on the blockchain. The new technology offers much faster processing times, transparent record keeping and automated lending processes with lower risk (Media, 2018).

Many major banks incorporate the new technology into their systems. For example ING and Credit Suisse completed the first successful securities lending transactions using blockchain technology (Suisse, 2018).

The opportunities of blockchain in the financial sector are broad and encompass: trade finance (supply chain documentation, invoicing and payments), mortgage lending, loans and crowdfunding for startups and small and medium-sized enterprises; insurance: automated claims processing, fraud prevention in luxury goods, and insurance for sharing economy (NullTX, 2018). Smart contracts make all mentioned operations automated and more efficient. In general, blockchain technology adoption in the finance sector has been driven by the potential savings arising from efficiency improvements, increased transparency, reducing fraud, and security of transactions.

Real Estate

Smart contracts can be applicable in the real estate business mainly to manage contracts, escrows,[1] conveyancing, property records and as a universal protocol for property buying. The main development within the blockchain implementation is the focusing on the automation of relevant processes and documentation on a decentralized blockchain platform.

For real estate business, smart contracts have the potential to increase financial privacy, speed up transactions, reduce costs and risk. Real estate's tech companies are developing smart contracts to improve existing processes, such as: property transfer, and recording including transactions. The blockchain technology is particularly attractive due to the enablement of paperless land transfer, easier and more accurate deed transfer, simplification of investment and ownership transfers, and reduction of inefficiencies in transactions (Deloitte, 2017).

[1] A bond, deed, or other document kept in the custody of a third party, taking effect only when a specified condition has been fulfilled.

Even though the real estate industry is still in the early phases when it comes to widespread adoption of blockchain, there are many initiatives which use the blockchain technologies, particularly as a basis for smart contract, such as velox.RE, Elea Labs, FeeSimple, ChromaWay, and many more.

Velox.RE (Velox.RE, 2018) has developed an open real estate platform that includes property transfer, recording and payments. It was the first platform that offers legal blockchain deed[2] software and procedural protocol. This platform is dedicated to real estate stakeholders to offer more transparency, liquidity, and profitability. Velox.Re platform is based on blockchain Bitcoin, which is a public digital ledger.

Elea Labs (EleaLabs, 2018) provide a platform for a real estate ecosystem, based on Bitcoin smart contracts. The Elea Labs project is a peer-to-peer network where users control data concerning the real estate they own, manage, and live in. Elea Labs claim that this platform will eliminate the complexity and costs associated with acquiring, operating and selling real estate property.

FeeSimple is an open source blockchain-based protocol that aims to solve the problems related to access to data, capital and ownership (EosProject, 2018). The platform is still under development. FeeSimple will facilitate accounting, online leasing, maintenance, crowdfunding, investor management, rent payment, property deeds and listings database.

One of the companies focused on a smart contract platform which is cooperating with the government is ChromaWay (ChromaWay, 2018). The company works with the Swedish National Land authority, Lantmäteriet, SBAB, Landshypotek Bank, Telia and "Kairos Future" to build applications on a private blockchain platform, mainly around real estate and finance, and related to mortgage origination, servicing, and closing processes, digital title management, and complex contractual workflows (Future, 2017). The ChromaWay platform includes Postchain, Esplix, and Token Technology. Postchain is described as a consortium database which is suitable for shared use only between members of a consortium (ChromaWay, 2018). Esplix coordinates and verifies business agreements and business workflows by using smart contracts (ChromaWay, 2018). Token Technology, coloured coins, which are extending the use of bitcoin by adding additional code allows, e.g., to share money from different accounts without the need to be part of the same bank.

[2]A legal document that is signed and delivered, especially one regarding the ownership of property or legal rights.

Supply Chains and Logistics

Supply chains and logistics are facing many challenges. The supply chain industry is struggling with complicated record keeping, traceability breaches, frauds, and visibility challenges. The logistic industry is very fragmented, which creates problems with transparency, unstandardized processes, low predictability and high costs.

The main role of smart contract applications in logistics and supply chains is to enable closer cooperation, better visibility into procurement, reduce auditing, increase trust, reduce costs, and to provide supply chain visibility and traceability (Lahoti, 2018).

The applications of blockchain technology to supply chains are compelling. Due to the fact that financial, physical and digital information are present on the blockchain, it is possible to reduce data redundancy across trading partners and to have a constantly updated inventory status for each product with full traceability. Moreover, smart contracts can integrate delivery and payment system.

Many big companies have started using blockchains in their logistic activities to improve supply chain transparency and monitor provenance. Companies like Maersk, IBM, Walmart, Unilever, Alibaba and UPS are monitoring products in their global supply chain by utilizing blockchain technology and smart contracts.

Maersk and IBM have established a global TradeLens blockchain-based platform (Tradelens, 2018) which allows each stakeholder in the supply chain to view the progress of goods through the supply chain, see the status of customs documents, and to view a detailed list of a shipment of goods, and other data. Both companies will sell access to the platform and each party will be contracting with their own customers. Since the establishment, TradeLens has logged over 224 million shipping events (Tradelens, 2018). A total of 90 organizations are now involved with TradeLens, including port and terminal operators, global container carriers, customs authorities, and logistics companies (IBM, Blockchain for supply chain, 2018). TradeLens claims to be an open and neutral industry platform.

Walmart and IBM have joined forces to develop "Food Safety Solution" (IBM, Blockchain in Food Safety, 2018) based on the IBM blockchain platform, which makes food traceability possible. As part of this initiative, all direct suppliers are required to conform to one-step back traceability on the IBM Food Trust blockchain network by Jan 31, 2019. Afterwards, Walmart suppliers are expected to work within their vertical systems or with their suppliers to enable end-to-end traceability back to 'the farm' by September 30, 2019 (Walmart, 2018). The IBM Blockchain platform is built on a hyperledger fabric which is a framework for distributed ledger solutions on permissioned networks.

Blockchain solutions are also widely implemented in transport and affiliated industries. Blockchain in Transport Alliance (BiTA, 2018) has more than 450 members in over 25 countries from freight, transport and logistic. BiTA's main activities are related to the creation of universal standards formation and promotion of blockchain technology in the freight industry. BiTA promises benefits to enterprises, such as lowering risks and costs for both carriers and shippers, free up capital, speed up processes and security and trust.

5 Analysis and Conclusion

The three cases presented show that blockchain technology is not only a future prospect. Blockchain technology is already used in various industries, but it is only in its infancy yet. An increasing number and variety of applications of blockchain will be developed and launched in the coming years and will gradually impact on business processes. Iansiti and Lakhani in their paper (Iansiti and Lakhani, 2017) suggest that the diffusion and adoption of blockchain technology will develop in phases, and that we have only seen the beginning of it. At the moment, blockchain technology is not in a phase where it radically changes business relations and structures. It is mainly used for improving existing processes and for lowering costs. And, it is even used for tightening the control of large players over their partners as is indicated in the example of IBM and Walmart.

Blockchain technology has been launched together with radical prospects of decentralization and removal of intermediaries. In principle, blockchain technology can potentially be implemented with these implications. However, much more empirical evidence concerning the actual use of this technology is needed in order to form a realistic picture of how these new technological potentials will evolve. In the papers referred to, first and foremost the Tapscott and Tapscott paper (2017), the similarities with Internet in terms of fundamental changes in industrial services and structures are discussed. As is well-known, it took Internet a good number of years of development before it really started impacting business developments and processes. It was the diffusion of the World Wide Web, which made the big difference and is also, in the broader public, considered as the start of Internet. It would seem that the development and diffusion of blockchain technology will be faster and that the better comparison is with the World Wide Web in terms of speed and spread.

Whether blockchain technology will have broad social and business effects anything similar to Internet is yet to be seen. With respect to the implications on transaction costs, the greatest effects of Internet have been on facilitating communications. This applies to the various e-commerce applications and it applies to the platform business models that have been springing up in the thousands. The general purpose of these platforms is to lower transaction costs and the engine is cross-side network effects. Whether blockchains have a similarly forceful engine is to be seen.

As has been mentioned and also pointed out by the papers referred to, the primary effect of blockchain technology on transaction costs are on the contracting part of business operations – while the primary effect of platforms are on the contacting parts (searching and communicating). But there is an overlap between platforms and blockchains, as platforms can also facilitate contracting and blockchains can also make communications easier by means of, for instance, increased transparency. However, the main effects of the two sets of institutional technologies, as Davidson et al. (2016) call them, have different emphases. The combination of these technologies constitutes a very strong basis for lowering transaction costs and changing business processes.

Whether blockchain technology will live up to the promises of doing away with the middleman and strengthening decentralization will very much depend on how blockchains are implemented and by whom. An expression of this is whether blockchains will be implemented as public, private or consortium, blockchains. The claims for transparency and openness are associated with these different forms of solutions.

The three cases that have been presented in this paper are all intermediary business areas. They obviously have a clear interest in experimenting with and implementing a set of technologies that potentially could change their business processes and areas. However, the manner in which they will do it will basically be to subsume these technologies under their control. Whether blockchain technology in itself will be a ‘technology of freedom’ or whether it will be made part of business processes still under the control of strong intermediaries is not clear yet.

References

Bartoletti, M., and Pompianu, L. (2017). An Empirical Analysis of Smart Contracts: Platforms, Applications, and Design Patterns. In: Brenner M. et al. (eds.) Financial Cryptography and Data Security. *Lecture Notes in Computer Science, Vol. 10323. Springer*.

Bisade, A. (2018, November 1). *Consortium Blockchain Explained*. Retrieved from https://www.mycryptopedia.com/consortium-blockchain-explained/

BiTA. (2018). *Blockchain in Transport Alliance*. Retrieved from https://bita.studio/

Bresnahan, T., and Trajtenberg, M. (1995). General purpose technologies: 'Engines of growth'. *Journal of Economics, 65*, pp. 83–108.

Catalini, and Gans. (2018). Some simple economics of the blockchain. *NBER Working Paper Series, Working Paper 22952*, 21.

Catalini, C. (2017). *How Blockchain Technology Will Impact the Digital Economy*. Retrieved from University of Oxford: https://www.law.ox.ac.uk/business-law-blog/blog/2017/04/how-blockchain-technology-will-impact-digital-economy

Christensen, C. (1997). The innovator's dilemma: When new technologies cause great firms to fail. *Harvard Business School Press*.

ChromaWay. (2018). *Platform*. Retrieved from https://chromaway.com/platform/

ChromaWay. (2018). *Postchain Blueprint an Introduction*. Retrieved from https://chromaway.com/papers/postchain-blueprint.pdf

Coase, R. (1937). The nature of the firm. *Economica, Vol. 4, No. 16*, 386–405.

Davidson, S., De Filippi, P., and Potts, J. (2016). Economics of blockchain, Public Choice Conference. May 2016, Fort Lauderdale, United States. ff10.2139/ssrn.2744751ff.ffhal-01382002f

Deloitte. (2017). *Blockchain in Commercial Real Estate. The Future is Here!* Retrieved from file:///C:/Paper_2018_Block_Chain/us-fsi-rec-blockchain-in-commercial-real-estate.pdf

Destefanis, G., Bracciali, A., and Ma, M. (2018). Smart Contracts Vulnerabilities: A Call for Blockchain Software Engineering? Campobasso, Italy: IEEE 19 IWBOSE 2018.

Eichkorn, D. (2018). *All About the Blockchain: The Next Generation of Cybersecurity*. Retrieved from https://www.gflesch.com/blog/all-about-blockchain

EleaLabs. (2018). *Shaping the Future of Real Estate with Cryptofinance Technology*. Retrieved from https://www.elea.io/

EosProject. (2018). *FreeSimple*. Retrieved from https://eosprojects.org/projects/p/feesimple/

Future, K. (2017). *The Land Registry in the Blockchain – Testbed*. Retrieved from file:///C:/Paper_2018_Block_Chain/Blockchain_Landregistry_Report_2017.pdf

Henten, A., and Windekilde, I. (2016). Transaction costs and the sharing economy. *Journal Info (Bingley)*.

Iansiti, M., and Lakhani, K. R. (2017). The truth about blockchain. *Harvard Business Review, January–February 2017*, pp. 3–11.

IBM. (2018). *Blockchain for Supply Chain*. Retrieved from https://www.ibm.com/blockchain/industries/supply-chain{#}1216816

IBM. (2018). *Blockchain in Food Safety*. Retrieved from https://www.ibm.com/blogs/blockchain/category/blockchain-in-food-safety/

Jensen, M., and Meckling, W. (1976). The theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, No. 3*, pp. 305–360.

Lahoti, N. (2018). *How Blockchain is Transforming Logistics and Supply Chain*. Retrieved from https://www.linkedin.com/pulse/how-blockchain-transforming-logistics-supply-chain-nitin-lahoti/

Media, C. (2018). *Blockchain-Based Lending*. Retrieved from https://media.consensys.net/blockchain-based-lending-1eee5edabe8a

MEDICI. (2018). *Know More About Blockchain: Overview, Technology, Application Areas and Use Cases*. Retrieved from https://gomedici.com/an-overview-of-blockchain-technology/

NullTX. (2018). *How to Use Smart Contracts in Banking?* Retrieved from https://nulltx.com/how-to-use-smart-contracts-in-banking/

Rooney, H. (2017). *Is Internal Audit Ready for Blockchain?* Retrieved from Technology Innovation Management Review: https://www.researchgate.net/publication/320680552_QA_Is_Internal_Audit_Ready_for_Blockchain

Suisse, C. (2018). *Credit Suisse and ING Execute First Live Transaction Using HQLAx Securities Lending App On R3's Corda Blockchain Platform*. Retrieved from https://www.credit-suisse.com/corporate/en/articles/media-releases/cs-and-ing-execute-first-live-transaction-201803.html

Szabo, N. (1994). *Smart Contracts*. Retrieved from http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart.contracts.html

Szabo, N. (1996). Smart Contracts: Building Blocks for Digital Markets. Retrieved from http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html

Szabo, N. (1997). Smart Contracts: Formalizing and Securing Relationships on Public Networks. *First Monday, Volume 2, Number 9, 1 September*.

Tapscott, D., and Tapscott, A. (2017). How blockchain will change organizations. *MITSloan Management Review, Vol. 58, No. 2*, pp. 10–13.

Tradelens. (2018). *The Power of the Ecosystem*. Retrieved from https://www.tradelens.com/ecosystem/

Velox.RE. (2018). *https://www.velox.re/*. Retrieved from https://www.velox.re/

Voshmgir, S. (2017). Disrupting governance with blockchains and smart contracts. *Wiley, Strategic Change, John Wiley and Sons, Ltd., 26(5)*, 499–509.

Walmart. (2018). *Food Traceability Initiative – Fresh Leafy Greens*. Retrieved from https://corporate.walmart.com/media-library/document/blockchain-supplier-letter-september-2018/_proxyDocument?id=00000166-088d-dc77-a7ff-4dff689f0001

Wiliamson, O. (1975). Markets and hierarchies: Analysis and antitrust implications.

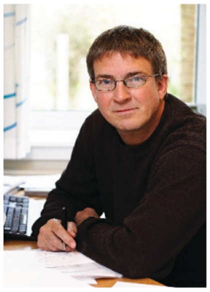
Wiliamson, O. (1979). Transaction-cost economics: The governance of contractual relations. pp. 233–261.

Wiliamson, O. (1984). The economics of governance: Framework and implications. pp. 195–223.

World Bank. (2018). *World Bank Mandates Commonwealth Bank of Australia for World's First Blockchain Bond*. Retrieved from https://www.worldbank.org/en/news/press-release/2018/08/09/world-bank-mandates-commonwealth-bank-of-australia-for-worlds-first-blockchain-bond

Zheng, Z., and Xie, S. (2017). An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends. *6th International Congress on Big Data.* IEEE.

Biographies



Anders Henten is Professor at section for Communication, Media and Information technologies (CMI) – an interdisciplinary research and teaching section specializing in ICT services, digital media and cyber security at the Department of Electronic Systems at Aalborg University in Copenhagen. He is a graduate in communications and international development studies from Roskilde University in Denmark (1989) and holds a PhD in ICT from the Technical University of Denmark (1995). He has worked professionally in the area of communications economy and policy for more than 30 years.

Iwona Windekilde is Associate Professor at CMI (Center for Communication, Media and Information Technologies) at Aalborg University. She holds a Ph.D. Degree in Economics from Szczecin University, Poland. From the year 2002 to 2005, she worked as an Assistant Professor at Szczecin University in Poland, at the Department of Economics and Organization of Telecommunication. In 2005, she received Marie Curie Intra-European Fellowships within the Sixth Framework Programme. In 2006, she was employed at Center for Information and Communication Technologies, the Technical University of

Denmark as a Post.doc researcher in the area of business models for personal electronic networks. During her work at CMI, she was involved in several international projects and she has published a number of publications within the areas of Green ICT, network economics, ICT innovation, business models for personal electronic networks, broadband development, telecom networks, IT and broadcasting.